

Shoulder Ultrasound: Anatomy and Scanning Techniques

Jon A. Jacobson, MD FACR

Professor of Radiology
Section Chief, Musculoskeletal Imaging



1

Disclosures

- Consultant: Bioclinica
- Book Royalties: Elsevier
- Contractor: POCUS PRO
- Advisory Board: Philips
- Not relevant to this talk

Syllabus and other educational material can be found at www.jacobsonmskus.com

Note: all images from the textbook *Fundamentals of Musculoskeletal Ultrasound* are copyrighted by Elsevier Inc.

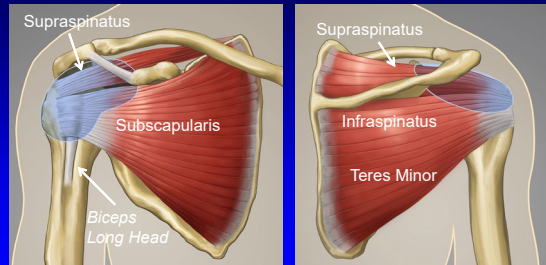
2

Rotator Cuff Anatomy:

- Supraspinatus
- Infraspinatus
- Teres Minor
- Subscapularis

3

Rotator Cuff

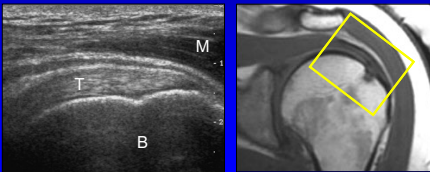


Note: Subacromial-subdeltoid Bursa (light blue)

4

Ultrasound Appearance:

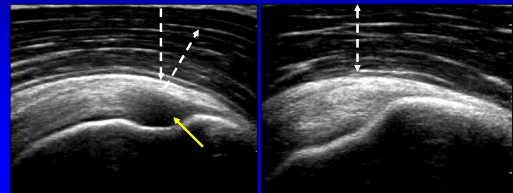
- Tendon: *hyperechoic*, fibrillar
- Muscle: relatively *hypoechoic*
- Bone cortex: *hyperechoic*, shadowing



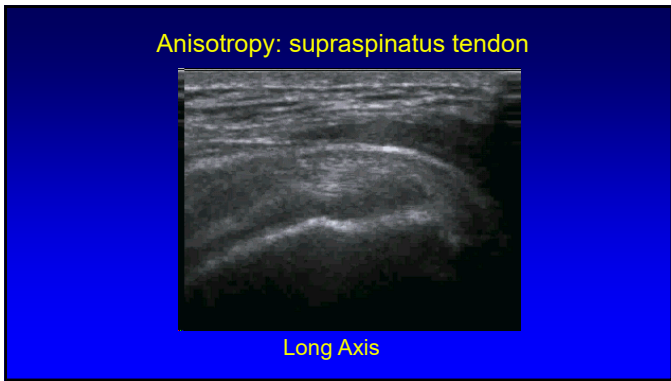
5

Anisotropic Effect

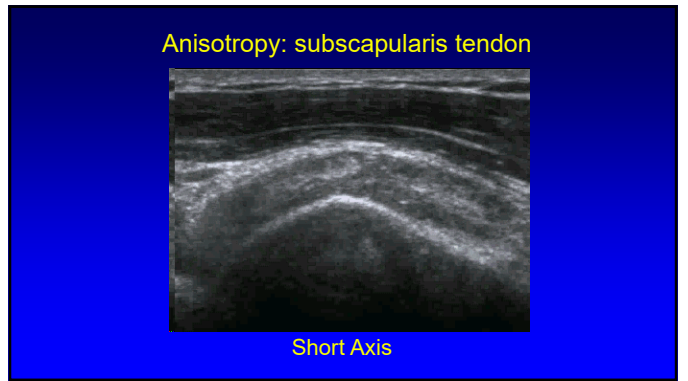
- Tendon is artifactually hypoechoic
- Sound beam is not perpendicular to fibers
- Tendon, ligament > muscle



6



7



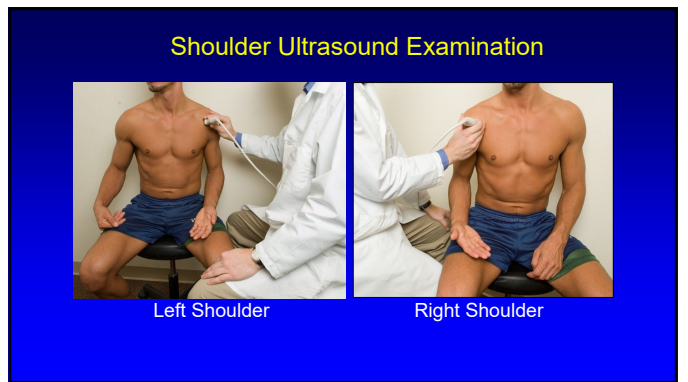
8

US: normal appearance

- Cartilage
 - Hyaline: hypoechoic
 - Fibrocartilage: hyperechoic
- Joint fluid
 - Simple: anechoic
 - Complex: mixed echogenicity

Infraspinatus
Glenoid
Humeral Head

9

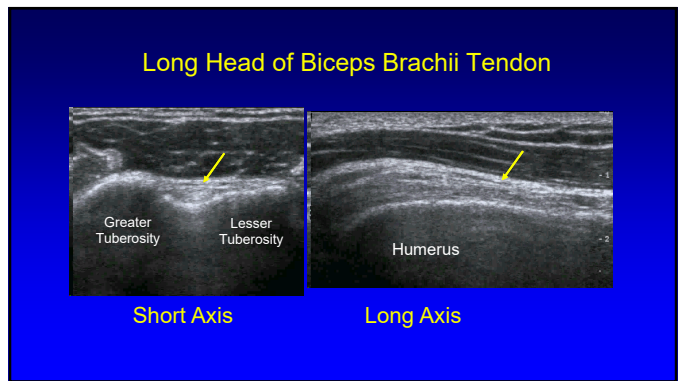


10

Technique: position #1

- Neutral, supination
 - Hand on lap, palm up
 - Anterior (10-17 MHz)
 - Biceps tendon:
 - Transverse, longitudinal

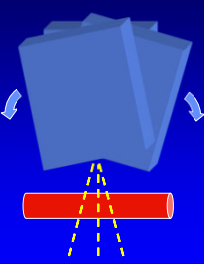
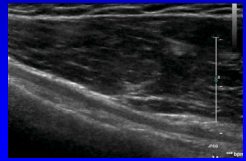
11



12

Scanning: basics

- Heel-toe maneuver
 - Evaluating long axis of tendon
 - Eliminate anisotropy

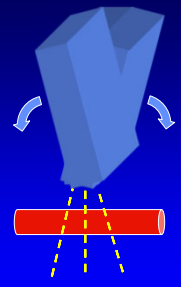
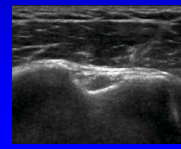



The diagram shows a blue 3D volume of a tendon being scanned from different angles, indicated by curved arrows. A red cylinder represents the tendon, and dashed yellow lines show the scanning planes. The ultrasound image shows a longitudinal view of the tendon with a vertical scale bar on the right.

13

Scanning: basics

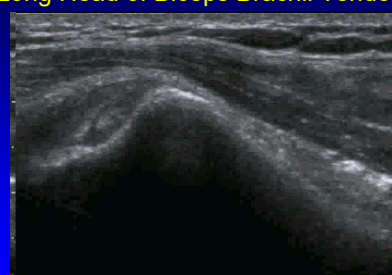
- Toggle
 - Evaluating short axis of tendon
 - Help identify tendon
 - Eliminate anisotropy

The diagram shows a blue 3D volume of a tendon being scanned from different angles, indicated by curved arrows. A red cylinder represents the tendon, and dashed yellow lines show the scanning planes. The ultrasound image shows a transverse view of the tendon.

14

Long Head of Biceps Brachii Tendon




Long Axis

This ultrasound image shows a longitudinal view of the long head of the biceps tendon, appearing as a thick, fibrillar structure with a curved shape.

15

Technique: position #2

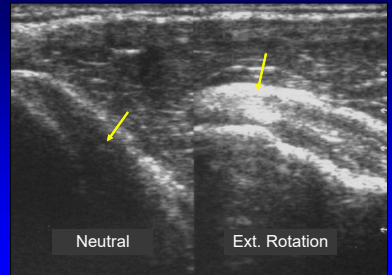
- External Rotation
 - Anterior
 - 10-17 MHz linear
- Subscapularis tendon
 - Longitudinal, transverse
- Biceps dislocation



The clinical photo shows a person's arm in external rotation with a hand on the shoulder, demonstrating the technique for scanning the subscapularis tendon.

16

External Shoulder Rotation

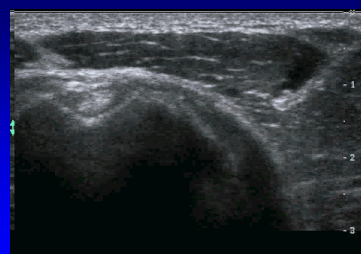


Subscapularis

The image shows two views of the subscapularis tendon. The left view is labeled 'Neutral' and the right view is labeled 'Ext. Rotation'. Yellow arrows point to the tendon in both views.

17

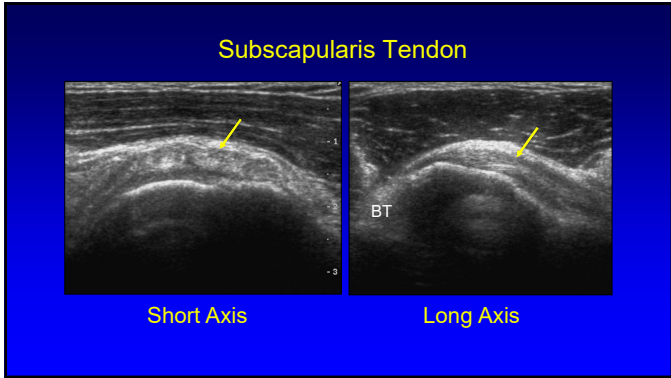
External Shoulder Rotation



Subscapularis

This ultrasound image shows the subscapularis tendon in external rotation, with a scale bar on the right side.

18

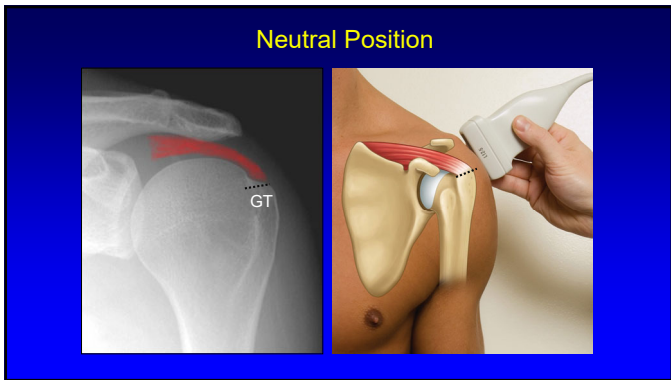


19

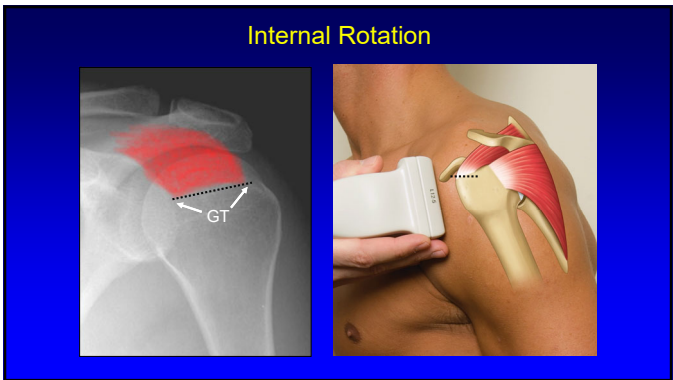
Technique: position #3

- Internal rotation, extension
 - Back of hand at other back pocket
 - Anterior (7-13 MHz linear)
 - **Supraspinatus**
 - Start longitudinal
 - Infraspinatus

20



21



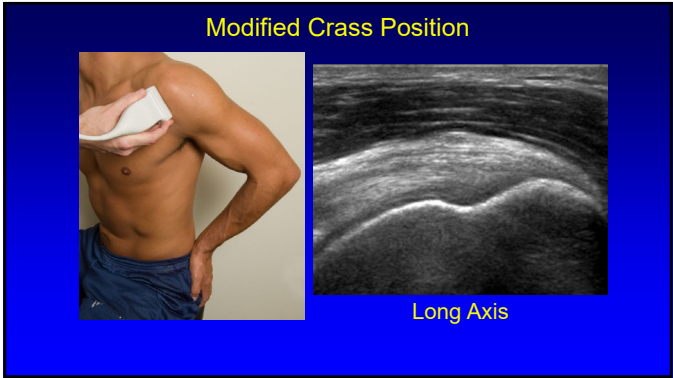
22

Technique: position #3

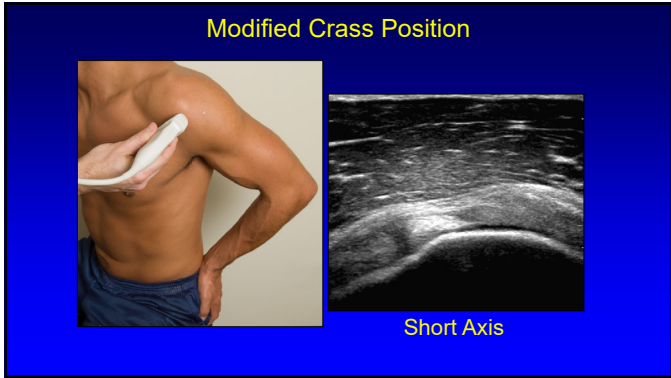
- Modified Crass
 - Hand at closest hip pocket
 - Easier to tolerate
 - Long axis: aim toward ear
 - Improved biceps visualization
 - Overestimates size*

Ferri, AJR 2005; 184:180

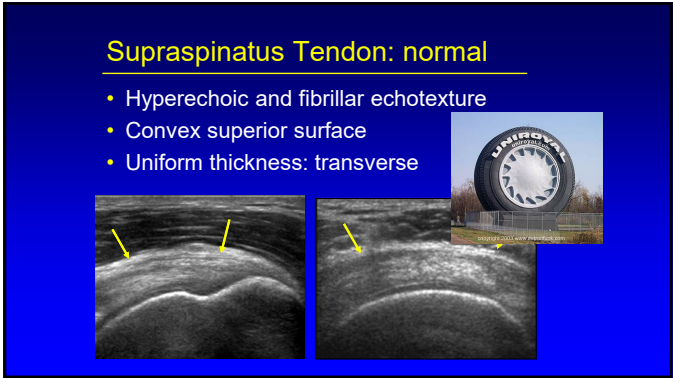
23



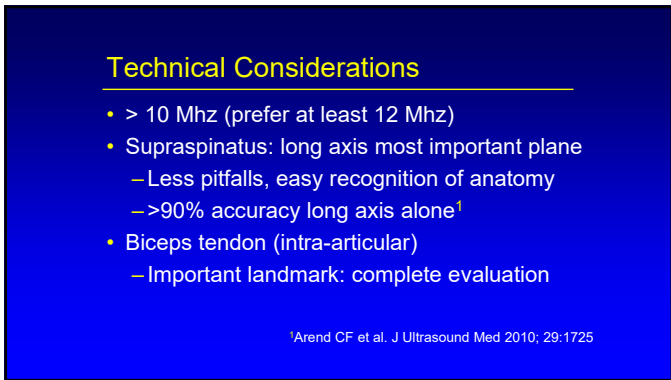
24



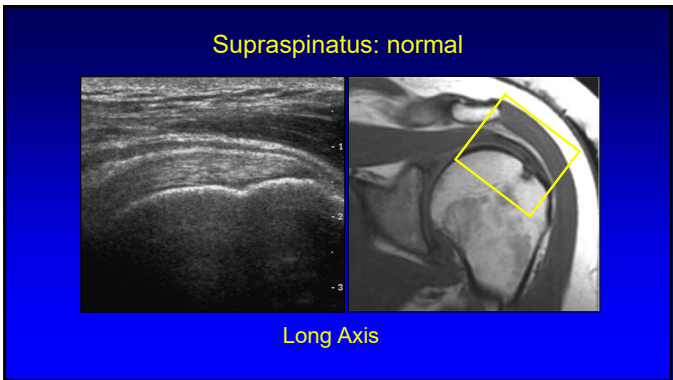
25



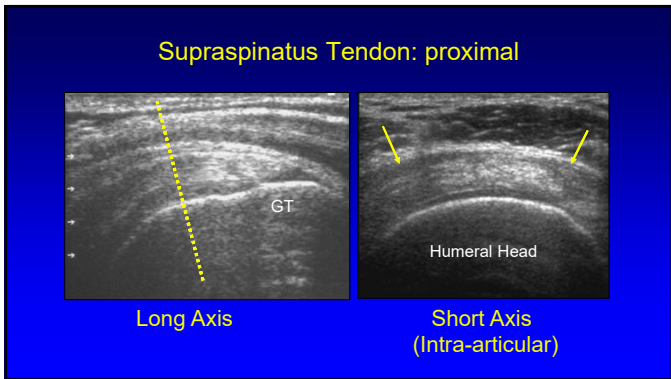
26



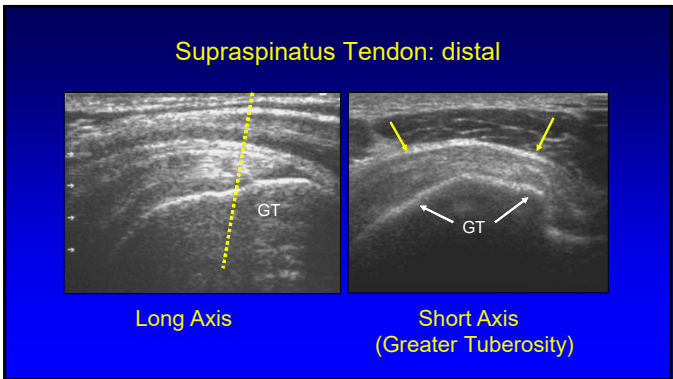
27



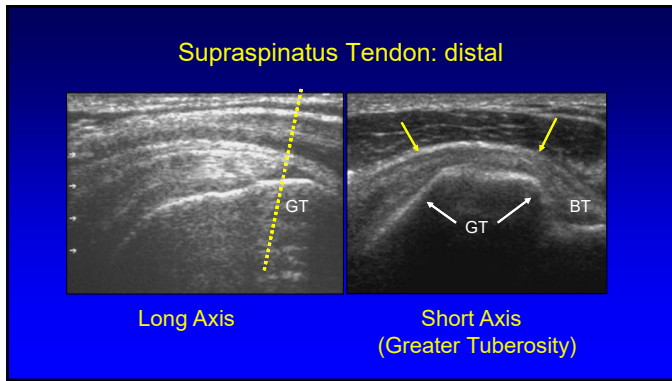
28



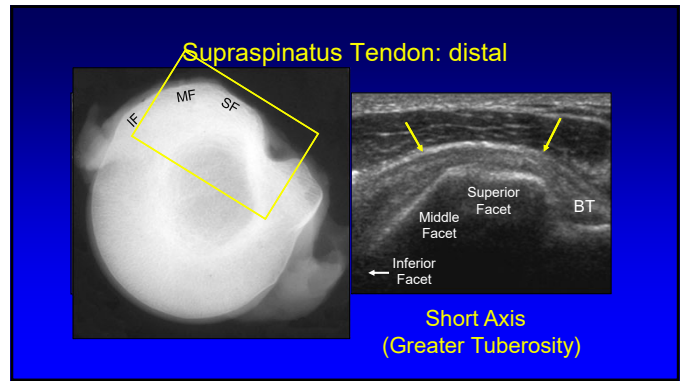
29



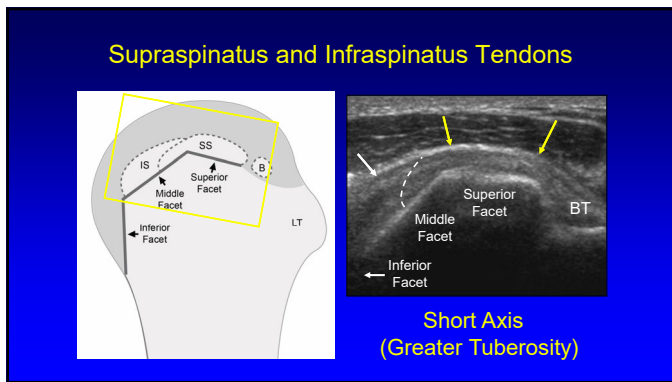
30



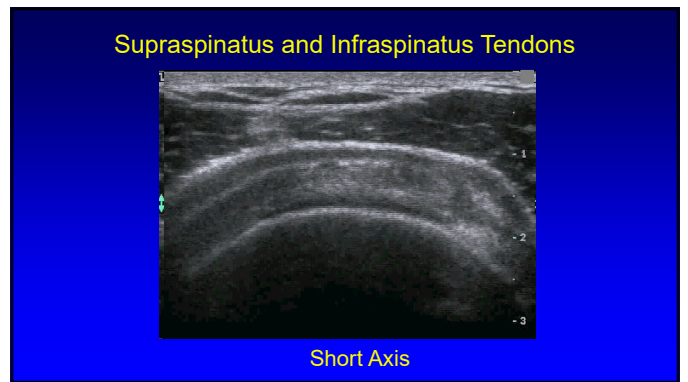
31



32



33

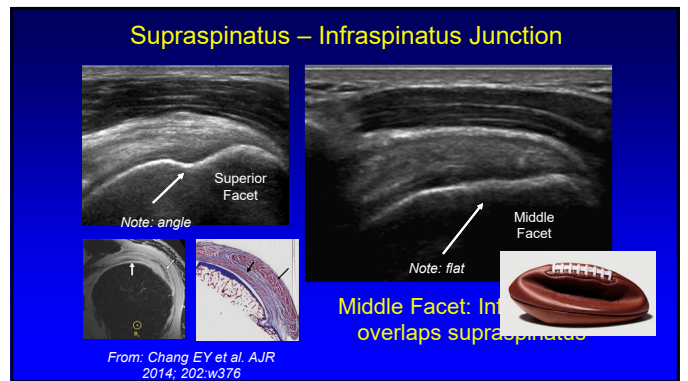


34

Supraspinatus - Infraspinatus Junction

- Longitudinal:
 - Flattening of greater tuberosity
 - Tendon striations: anisotropy infraspinatus
- Transverse:
 - 1.3 – 2.3 cm posterior to biceps tendon
 - Infraspinatus overlaps supraspinatus
 - Slight volume loss

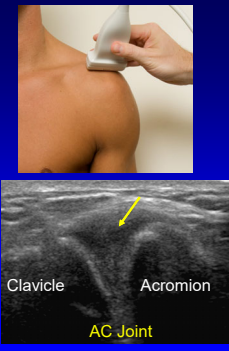
35



36

Technique: position #4

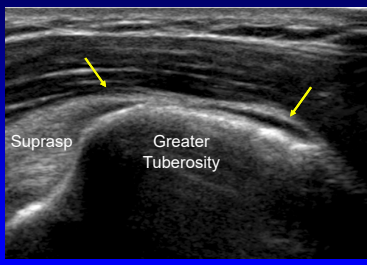
- Neutral position
 - 10-17 MHz linear
 - Acromioclavicular joint
 - Subacromial-subdeltoid bursa
 - Dynamic: impingement



Clavicle Acromion
AC Joint


37

Subacromial-subdeltoid Bursa



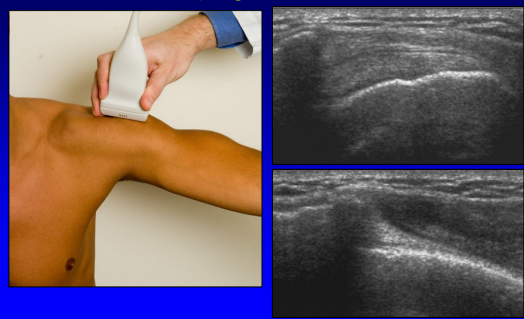
Suprasp Greater Tuberosity

Coronal



38

Impingement Test



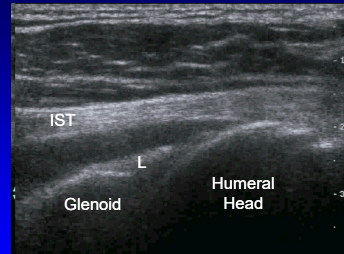
39

Technique: position #5

- Neutral position: posterior (5 – 12 MHz)
 - A. Posterior glenohumeral joint
 - Joint recess, infraspinatus
 - Labrum, spinoglenoid notch
 - B. Muscle atrophy
 - C. Suprascapular notch
 - Superior labrum


40

Infraspinatus Tendon & Posterior Labrum



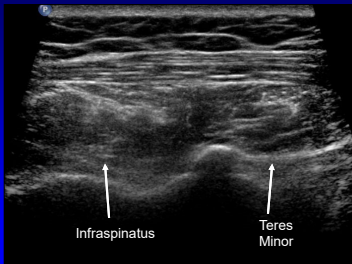
IST L Humeral Head
Glenoid

Infraspinatus: Long Axis



41

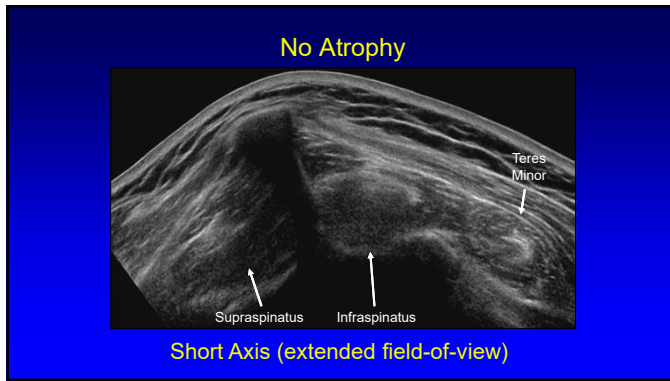
No Atrophy



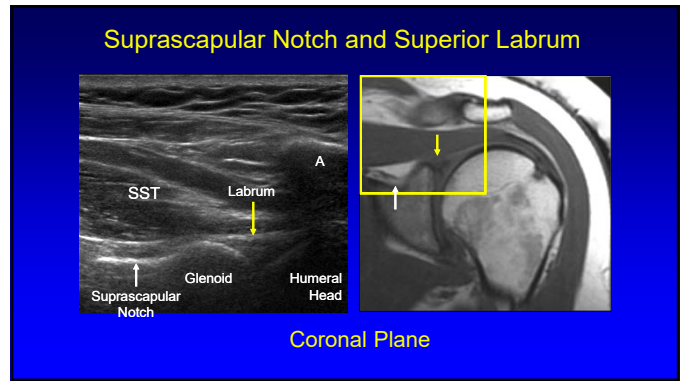
Infraspinatus Teres Minor

Short Axis

42



43



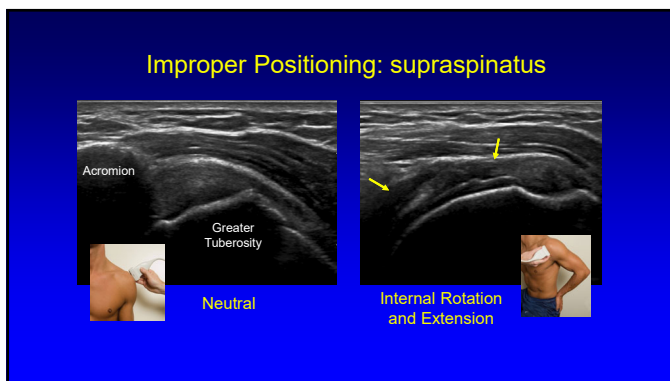
44

- Pitfall: technique**
- Improper arm position
 - Incomplete evaluation of the supraspinatus
 - Transverse imaging too distal
 - Anisotropy
 - Measuring cuff tear

45

- Improper Arm Position:**
- Inadequate internal rotation/extension
 - Supraspinatus is hidden beneath acromion

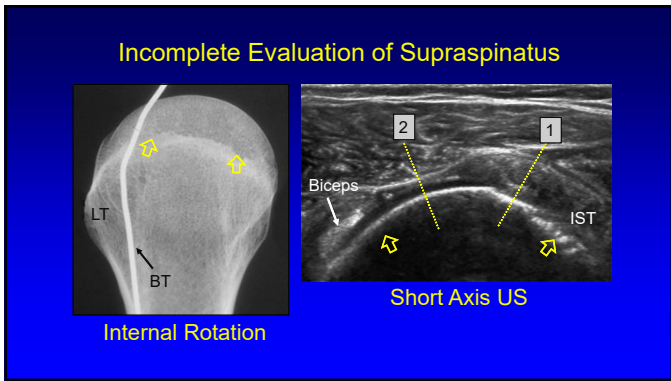
46



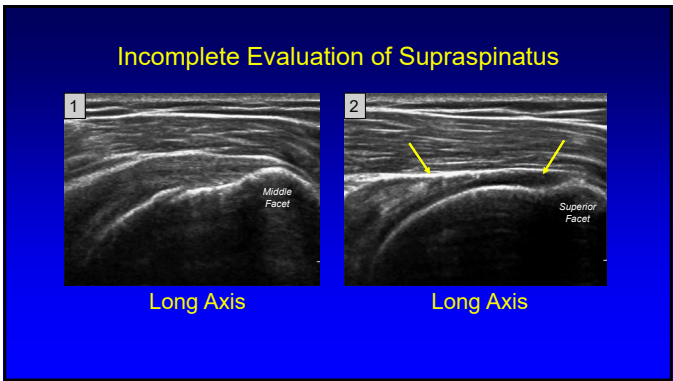
47

- Incomplete Evaluation of Supraspinatus:**
- Scan entire width of greater tuberosity
 - Many tears occur anteriorly over superior facet
 - Include biceps on transverse image as landmark

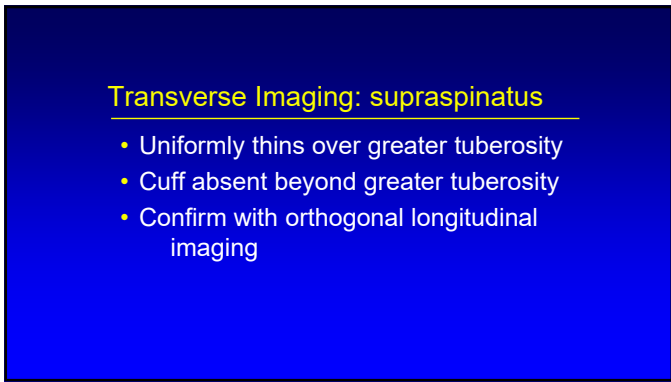
48



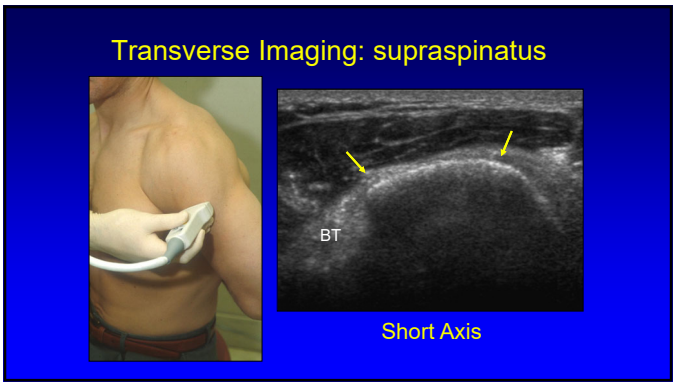
49



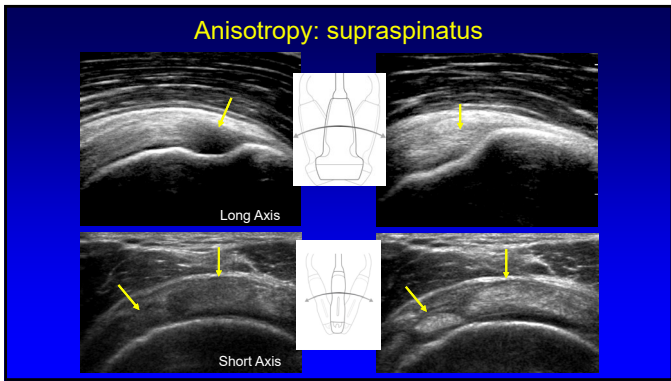
50



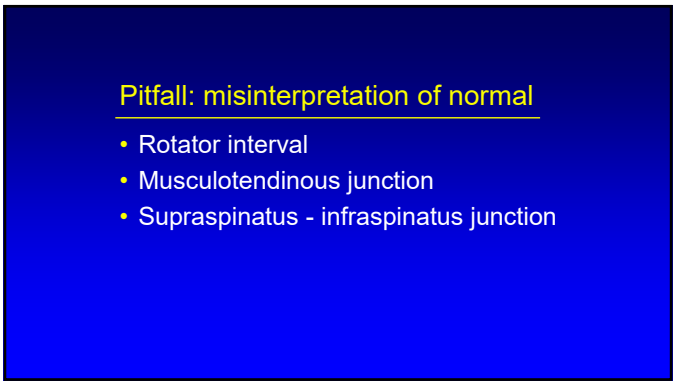
51



52



53



54

Misinterpretation of Rotator Interval:

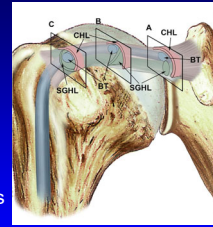
- Intra-articular portion of biceps tendon
- Hyperechoic
- Adjacent hypoechoic gap*
- May simulate tear

*Middleton et al. AJR 1986; 146:555

55

Biceps Brachii: anatomy

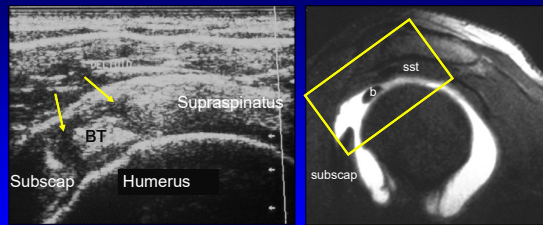
- Origin: supraglenoid tubercle of scapula and labrum
- Reflection pulley: stability
 - Coracohumeral ligament
 - Superior glenohumeral ligament
 - Superior aspect of subscapularis



From: Ding et al. JBJS 2015; 96:E176

56

Rotator Interval



Short Axis US

Sag-obl MR Arthrogram

57

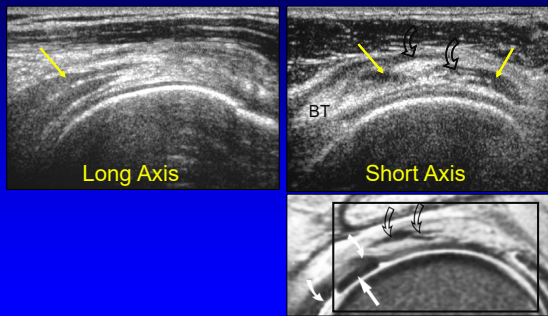
Musculotendinous Junction:

- **Supraspinatus:** several distinct tendons
- Appears as hypoechoic area extending into tendon
- Usually terminates by mid-tendon
- Characteristic tapering from proximal to distal

Turrin et al. Skeletal Radiology 1997; 26:89

58

Musculotendinous Junction: supraspinatus



Long Axis

Short Axis

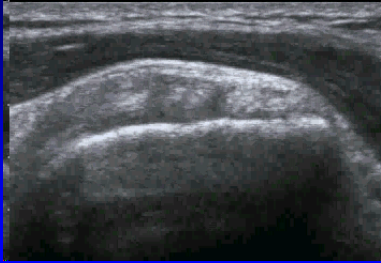
59

Musculotendinous Junction:

- **Subscapularis:** several distinct tendons
- Appears as hypoechoic area extending into tendon
- Heterogeneous to lesser tuberosity

60

Musculotendinous Junction: subscapularis



Short Axis

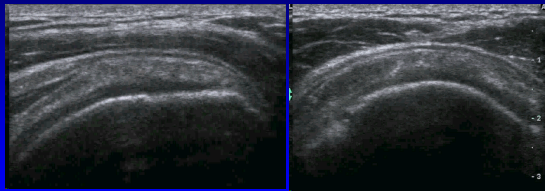
61

Supraspinatus - Infraspinatus Junction

- Converging fibers – posterior
 - Over middle facet of greater tuberosity
- Hypoechoic fibers: anisotropy
- Regular intervals

62

Supraspinatus - Infraspinatus Junction

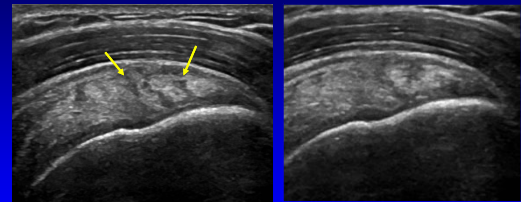


Long Axis

Short Axis

63

Supraspinatus – Infraspinatus Junction

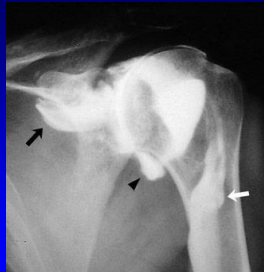


Long Axis to Supraspinatus over Middle Facet

64

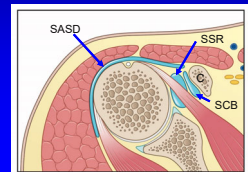
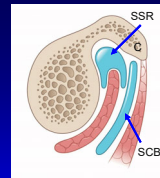
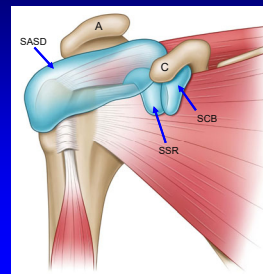
Shoulder Joint Recesses

- Long head biceps tendon sheath
- Posterior recess:
 - Image with shoulder in external rotation
- Axillary recess
- Subscapularis recess



65

Subacromial-subdeltoid bursa (SASD) vs. subscapularis recess (SSR) vs. subcoracoid bursa (SCB)



66

Take-home Points

- Must follow a protocol
- Important landmarks:
 - Greater tuberosity facet anatomy
 - Rotator interval
- Pitfalls:
 - Anisotropy
 - Incomplete evaluation of supraspinatus

67



Syllabus on line and additional educational material:
www.jacobsonmskus.com

Twitter handle: @jjacobsn

68